



ELSEVIER

Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Trauma Case Reports

journal homepage: www.elsevier.com/locate/tcr

Case Report

Patient experience from a doctor's perspective: A case report concerning treatment, fracture healing and rehabilitation of multiple complex injuries due to a high energy motor vehicle collision

M.A. de Ruijter^{a,*}, J.A. Lucke^b, J.Z. Yuan^a, R.J. Derksen^a^a Department of Traumasurgery, Zaandam Medical Centre, Zaandam, the Netherlands^b Department of Emergency Medicine, Spaarne Gasthuis, Haarlem, the Netherlands

ARTICLE INFO

Keywords:

Trauma
Femoral fracture
Lisfranc injury
Carpal fracture
Rehabilitation
Patient experience

ABSTRACT

A 35-year old healthy male trauma surgery chief resident, suffered a high-speed motor vehicle collision. The patient sustained the following injuries: a Gustilo-Anderson grade 2 open comminuted intra-articular fracture of the left distal femur (AO 33C3.3), a Hawkins 1A neck fracture of the right talus (AO 81.2A), an undisplaced Lisfranc injury of the right foot comprising avulsion fractures at the base of the 1st, 2nd and 5th metatarsal as well as the cuboid bone suggesting ligament injury and 2nd to 5th carpometacarpal dislocations of the right (non-dominant) hand with comminuted fractures of the capitate, hamate, trapezoid and the base of the fifth metacarpal bone. A staged-treatment approach ensued. An external fixator (ex-fix) was placed over the left knee, followed by definitive fixation of the distal femoral fracture using a Qwix screw, Non-Contact Bridging (NCB) plate and Locking Compression Plate (LCP). An ex-fix was placed over the right wrist, followed by open reduction and k-wire fixation. The talar fracture of the right foot was treated with a single lag screw and the Lisfranc injury was treated non-operatively with four weeks of non-weight bearing cast immobilization.

An intensive clinical rehabilitation program was started, including early use of Continuous Passive Motion (CPM), daily non-weightbearing swimming pool exercises, hand, physical and recreational therapy. One year after the injury the patient was rehabilitated and resumed his surgical residency. Two years after the injury, limited flexion and pain in the left leg remains, possibly related to partial union of the femoral fracture. Range of motion (ROM) of the right ankle and wrist remains limited, not causing significant functional impairment. Lessons learned from a patient experience combined with detailed descriptions of injuries, rehabilitation and long term outcomes can be used as a reference for treating patients with comparable injuries.

Injury

A 35-year old healthy trauma surgery chief resident suffered a head-to-head high-speed motor vehicle collision while being abroad.

* Corresponding author at: Department of Traumasurgery, Zaandam Medical Centre, Koningin Julianaplein 58, 1502 DV Zaandam, the Netherlands.

E-mail address: ricco.deruijter@gmail.com (M.A. de Ruijter).

<https://doi.org/10.1016/j.tcr.2022.100699>

Accepted 2 October 2022

2352-6440/© 2022 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Extrication due to entrapment took 2 h. He sustained multiple extremity injuries: a Gustilo-Anderson grade 2 comminuted intra-articular fracture of the left distal femur (AO 33C3.3), a Hawkins 1A neck fracture (AO 81.2A) of the right talus, an undisplaced Lisfranc injury of the right foot comprising avulsion fractures at the base of the 1st, 2nd and 5th metatarsal as well as the cuboid bone suggesting ligament injury and 2nd to 5th carpometacarpal dislocations of the right (non-dominant) hand with comminuted fractures of the capitate, hamate, trapezoid and the base of the fifth metacarpal bone. All being typical car accident injuries caused by impact of dashboard, gas pedal [1] and steering wheel [2].

Surgical treatment

Femoral fracture

After 24 h in traction the wound was debrided and an ex-fix was placed over the knee. Ten days later bilateral femoral plating was performed. The lateral condyle was reconstructed using a Qwix Fixation Screw (Integra LifeSciences, Princeton, USA). A distal femur NCB-plate (Zimmer, Warsaw, USA) was placed laterally (Fig. 1) as this plate showed good results previously [3,4]. A straight small fragment LCP plate (DePuy Synthes, Raynham, USA) was placed medially followed by eight weeks non-weightbearing. After seven months a screw was removed from the intercondylar notch, as it limited ROM of the knee.

Foot fractures

The talar fracture was percutaneously fixed by a lag screw (Fig. 2). Lisfranc fractures were treated conservatively in a cast (four weeks non-weightbearing, two weeks weightbearing). Weightbearing radiographs showed no tarsometatarsal dislocation/subluxation.

Hand fractures

An ex-fix was applied on the distal radius and 2nd metatarsal to stabilize the reduced carpometacarpal fracture-dislocations, complicated by neuropraxia of the superficial radial nerve. After ten days, open reduction and k-wire fixation was performed (Fig. 3) followed by six weeks of non-weightbearing cast. After six weeks, the k-wires were removed.

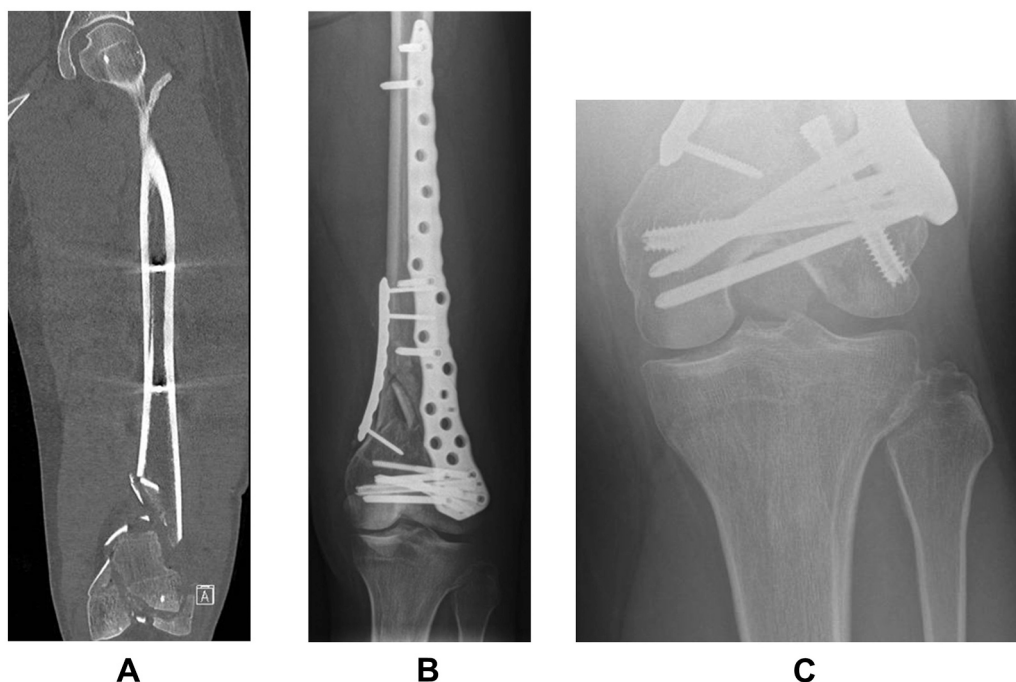


Fig. 1. Panel A: Coronal CT-view of left femoral fracture.
Panel B: AP X-ray, showing bilateral plating and consolidation after two months.
Panel C: AP X-ray, showing a screw in the notch of the left femur.

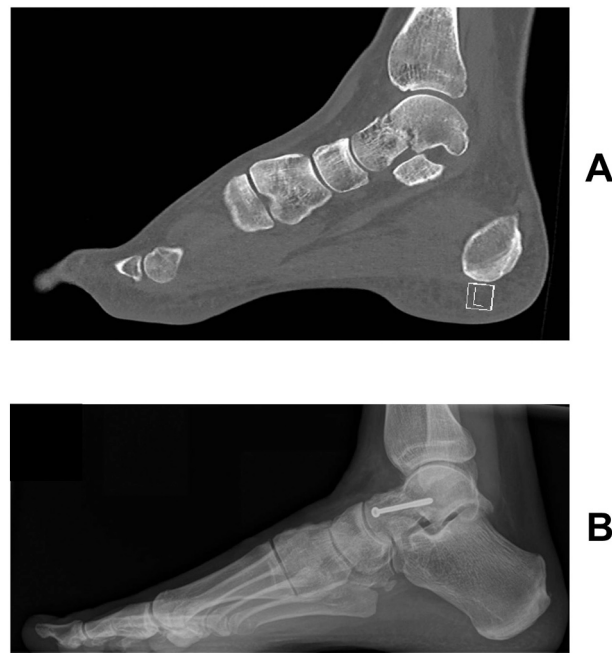


Fig. 2. Panel A: Sagittal CT-view of right talar fracture.
 Panel B: Lateral weightbearing X-ray, showing the single screw used to fixate the talar fracture and no luxation of the Lisfranc joints.

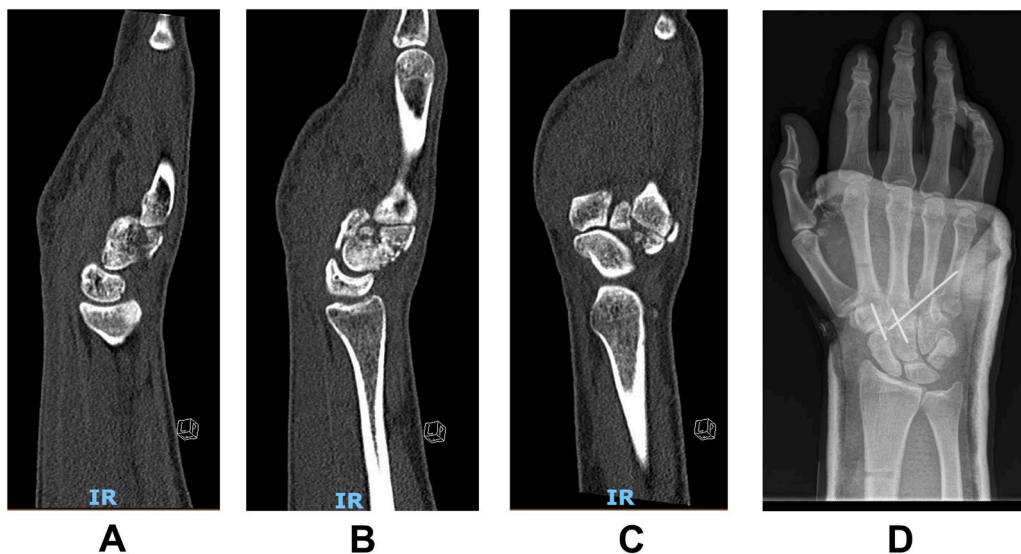


Fig. 3. Panel A: Sagittal CT-view of right hand, showing hamate fracture.
 Panel B: Sagittal CT-view of right hand, showing capitate fracture.
 Panel C: Sagittal CT-view of right hand, showing trapezoid fracture.
 Panel D: AP X-ray of right hand showing k-wire fixation.

Considerations

External fixators were chosen over immediate ORIF to facilitate early repatriation and improve soft tissue condition. Staged treatment has been suggested to be beneficial in lower limb injuries, therefore definitive osteosynthesis was postponed until ten days after trauma [5]. In a preferred local hospital, a multidisciplinary team was assembled consisting of a trauma, foot and plastic surgeon operating simultaneously. By using a minimally invasive technique and controversial early weightbearing on the right foot [6], rehabilitation of the femoral fracture was facilitated.

Rehabilitation

Given his high demanding profession, the patient was referred for clinical rehabilitation two weeks after surgery in order to work on all injuries simultaneously and maintain physical fitness guided by a multidisciplinary rehabilitation team.

Non-weightbearing exercise

The left leg was mobilized by CPM to improve cartilage repair and ROM [7]. Daily swimming pool therapy was started enabling non-weightbearing walking exercises and train ROM of all affected joints. Week-by-week the swimming pool floor was gradually raised, increasing gravity and experienced weightbearing.

Physical therapy

The hand injury precluded walking with conventional crutches. After six weeks in a wheelchair, the patient was trained to mobilize using customized aids. Within 12 weeks he was able to walk using a single cane in the non-injured hand. Long term physical therapy was continued for three hours weekly. Initially physiotherapy was aimed to improve muscle strength, coordination and joint stability, later this shifted toward maintaining function as less exercise caused functional decline.

Hand therapy

Dedicated hand therapy was provided to train ROM, strength, speed and accuracy of the right hand as well as coping with neuropathia of the superficial radial nerve.

Recreational activities

Sport activities like wheelchair badminton were strongly encouraged. Recreational activities such as crafting and playing the piano complemented hand therapy. Combining therapy with group activities and recreational exercises proved beneficial for perseverance and mental wellbeing, another advantage of clinical rehabilitation.

Lessons learned from a patients' perspective

Several lessons can be learned from experiencing the patients' perspective as a doctor. Firstly, clear doctor-patient communication is paramount. Being able to experience fellow rehabilitants' course from nearby, revealed the lack of understanding and often unrealistic expectations concerning recovery, duration and remaining disabilities leading to incomprehension and demotivated patients, regardless of their educational attainment and attending physician. Secondly, the added value of clinical rehabilitation should not be underestimated. A dedicated multidisciplinary (para)medical team, immediate availability of customized aids and a full-time training program accelerate recovery. Staying in an environment adapted to people with disabilities, makes life less dependent which can be psychologically beneficial. Same applies to sharing experiences with fellow rehabilitants.

Psychosocial impact can be severe. Inability to work or fulfil domestic duties can lower self-esteem. Sudden disruption of daily life causes an extra burden for relatives. Dealing with uncertainties concerning pain, recovery and financial consequences might require professional help.

Over time physical recovery decelerates and a plateau phase is reached. Acceptance of remaining impairments can be tough. A need for coaching should be anticipated on since regular medical follow-up might already have been completed.

For a doctor, having personally experienced treatment and rehabilitation is of great value to treating patients in a holistic way. Improved empathy, understanding the importance of individualized rehabilitation goals, awareness of potential medical incomprehension by patients and providing psychological support when needed, can add to improved therapy compliance and patient satisfaction.

Functional outcomes

The SF-12 score after two years was 46.4, the HSS score was 86 which is comparable to that of similar patients [3]. The 4-second peak load during the last two years is shown in Supplemental Fig. 1 and shows a decrease in strength of the affected leg in the past six months, ever since focus of physical therapy has changed from muscle strength to coordination. The current ROM of the affected limbs is less than the contralateral side (Supplemental Table 1). The left femur is now significantly shorter, contributing to an abnormal gait. Using a 1.2 inch shoe inlay compensates this partially. Prolonged standing causes minimally restrictive pain and swelling of the left knee. Sport activities such as mountain biking and running (maximum 1 mile) are possible, yet walking longer distances poses a challenge especially on irregular surfaces. The right foot and hand injury cause minor pain at intermittent intervals.

Discussion

A CT-scan performed two years after osteosynthesis showed partial union of the left femur (Fig. 4). Nonunion in distal femur

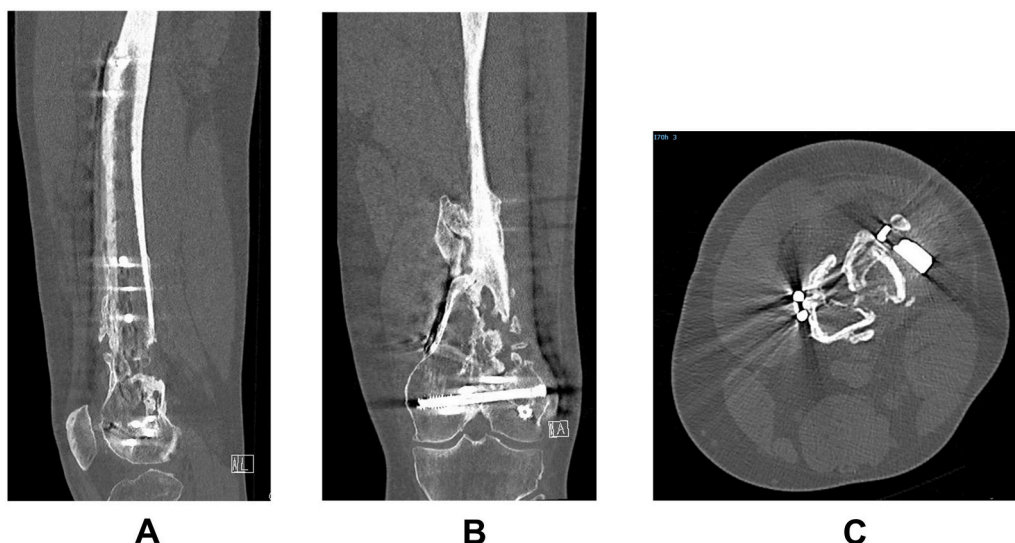


Fig. 4. Panel A: Sagittal CT-view of left leg showing partial union.
 Panel B: Coronal CT-view of left leg showing partial union.
 Panel C: Transversal C- view of left leg showing partial union.

fractures occur in up to 20 % of patients, more often in comminuted fractures that have been treated with stainless steel plates possibly providing too much rigidity which inhibits callus formation [8]. The patient has both titanium and stainless steel plates. It is hypothesized that despite partial union, bilateral plating facilitates full weightbearing and acceptable function without hardware failure after two years. Available literature shows varying success rates in treatment of distal femur nonunion with ORIF revision, iliac crest stem cell treatments and/or bone graft substitutes [9,10]. Due to the uncertain outcome, currently acceptable function and reluctance to having to rehabilitate again, revision surgery or other treatment steps have not been planned.

The right foot healed without complications speaking to the benefits of minimally invasive surgery. Acceptance of a slight talar dyscongruence, conservative treatment of the Lisfranc injury and relatively early weightbearing proved successful. Fractures of the right hand also healed without complications, showing the beneficial outcome of temporary k-wire fixation in carpometacarpal injuries.

Treating multiple extremity injuries simultaneously, requires adequate pre-operative planning including consideration of anatomical reduction versus inflicted surgical trauma and providing stability as needed for swift rehabilitation. Adequate rehabilitation in multi-trauma patients is related to but not solely determined by physical healing. Providing multidisciplinary psychosocial help can be of essential importance. Clinical rehabilitation was of great value, even in the non-weightbearing early phase of recovery. Keeping patients fully informed about treatment options, lasting impairments and psychological challenges being faced poses a challenge for doctors yet should be highly prioritized.

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.tcr.2022.100699>.

CRedit authorship contribution statement

M.A. de Ruijter: Conceptualization, Investigation, Writing – original draft. **J.A. Lucke:** Conceptualization, Visualization, Writing – review & editing. **J.Z. Yuan:** Writing – review & editing. **R.J. Derksen:** Writing – review & editing.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgements

We would like to thank Dr. S. D. Strackee (plastic hand surgeon of the Amsterdam University Medical Center), P. Veenman (physical therapist), as well as the caregivers of the rehabilitation clinic for providing excellent patient care.

Previous presentations

This case report was not presented at any meeting.

References

- [1] S.A. Fadl, C.K. Sandstrom, Pattern recognition: a mechanism-based approach to injury detection after motor vehicle collisions, *Radiographics* 39 (2019) 857–876.
- [2] J. Keith, R. Wollstein, Combined dislocation of the trapezoid and finger carpometacarpal joints-the steering wheel injury: case report, *J. Hand Surg. Am.* 35 (2010) 1454–1456.
- [3] J.B. Erhardt, M. Vincenti, J. Pressmar, F.A. Kuelling, C. Spross, F. Gebhard, et al., Mid term results of distal femoral fractures treated with a polyaxial locking plate: a multi-center study, *Open Orthop. J.* 8 (2014) 34–40.
- [4] M. Hanschen, I.M. Aschenbrenner, K. Fehske, S. Kirchoff, L. Keil, B.M. Holzapfel, et al., Mono- versus polyaxial locking plates in distal femur fractures: a prospective randomized multicentre clinical trial, *Int. Orthop.* 38 (2014) 857–863.
- [5] Y. Andonov, T. Solokov, P. Parashkevova, Staged treatment of high energy lower limb fractures, *J. IMAB* 25 (3) (2019 Jul-Sep), 2769–2682.
- [6] U.S. Grewal, K. Onubogu, C. Southgate, B.S. Dhinsa, Lisfranc injury: a review and simplified treatment algorithm, *Foot (Edinb.)* 45 (2020), 101719.
- [7] L.L. Onderko, S. Rehman, Treatment of articular fractures with continuous passive motion, *Orthop. Clin. N.Am.* 44 (2013) 345–356, ix.
- [8] C.E. Henderson, T.J. Lujan, L.L. Kuhl, M. Bottlang, D.C. Fitzpatrick, J.L. Marsh, 2010 mid-america orthopaedic association physician in training award: healing complications are common after locked plating for distal femur fractures, *Clin. Orthop. Relat. Res.* 469 (2011) 1757–1765.
- [9] N.A. Ebraheim, G.S. Buchanan, X. Liu, M.E. Cooper, N. Peters, J.A. Hessey, et al., Treatment of distal femur nonunion following initial fixation with a lateral locking plate, *Orthop. Surg.* 8 (2016) 323–330.
- [10] C.H. Ma, Y.C. Chiu, Y.K. Tu, C.Y. Yen, C.H. Wu, Three-stage treatment protocol for recalcitrant distal femoral nonunion, *Arch. Orthop. Trauma Surg.* 137 (2017) 489–498.